NAT'L INST. OF STAND & TECH R.I.C.
A11103 951909
NIST PUBLICATIONS

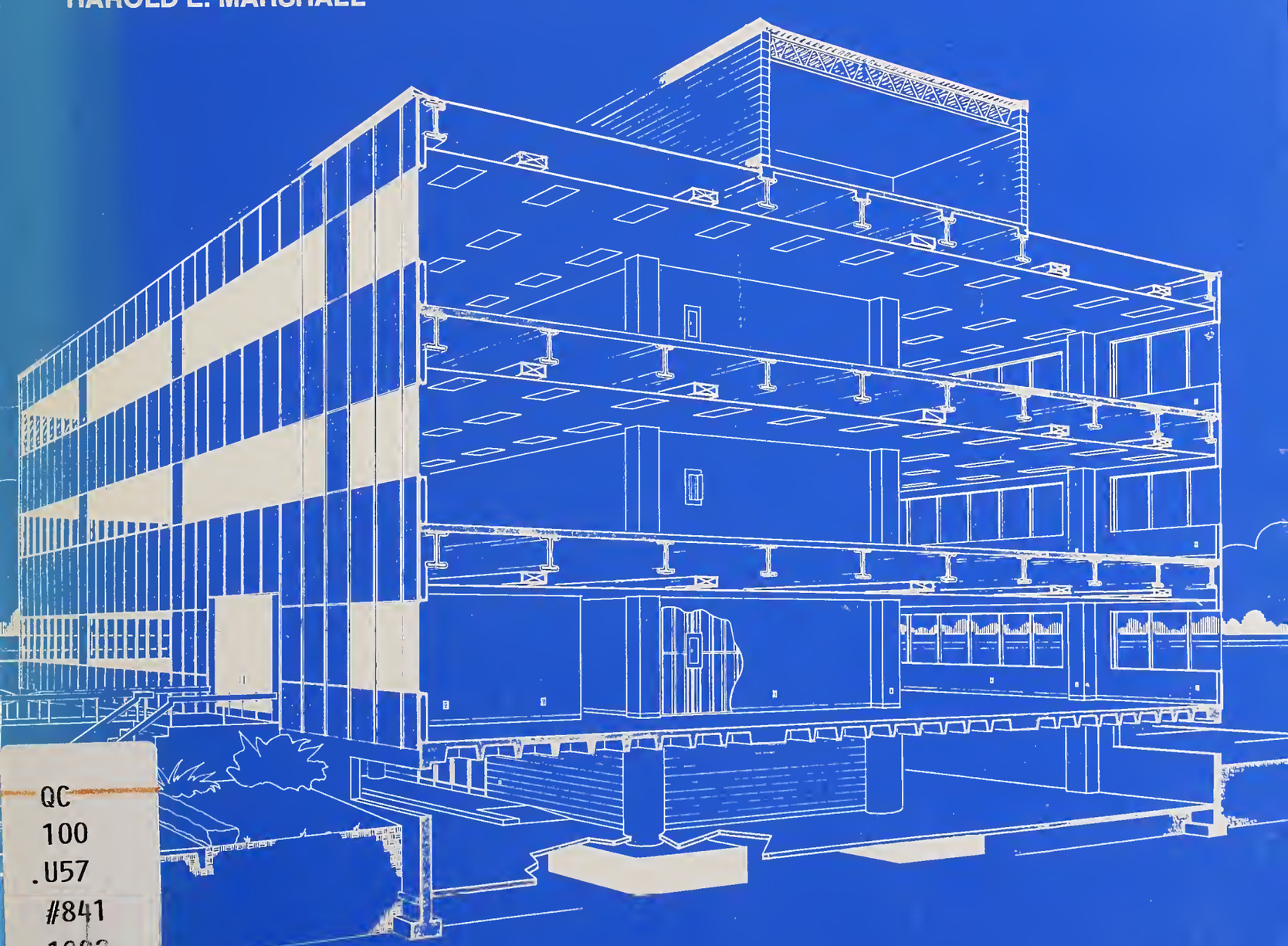
U. S. DEPARTMENT OF COMMERCE
TECHNOLOGY ADMINISTRATION
National Institute of Standards and Technology

NIST SPECIAL PUBLICATION 841

UNIFORMAT II

A Recommended Classification for Building Elements and Related Sitework

BRIAN BOWEN
ROBERT P. CHARETTE
HAROLD E. MARSHALL



QC
100
.U57
#841
1992

UNIFORMAT II Classification of Building Elements

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
SUBSTRUCTURE	Foundations	Standard Foundations Special Foundations Slab on Grade
	Basement Construction	Basement Excavation Basement Walls
SHELL	Superstructure	Floor Construction Roof Construction
	Exterior Closure	Exterior Walls Windows Exterior Doors
	Roofing	Roof Coverings Roof Openings
INTERIORS	Interior Construction	Partitions Interior Doors Specialties
	Staircases	Stair Construction Stair Finishes
	Interior Finishes	Wall Finishes Floor Finishes Ceiling Finishes
SERVICES	Conveying Systems	Elevators Escalators & Moving Walks Material Handling Systems
	Plumbing	Plumbing Fixtures Domestic Water Sanitary Waste Rain Water Drainage Special Plumbing Systems
	HVAC	Energy Supply Heat Generating Systems Cooling Generating Systems Distribution Systems Terminal & Package Units Controls & Instrumentation Special HVAC Systems & Equipment Systems Testing & Balancing

(CONTINUED ON INSIDE OF BACK COVER)

QC
100
.U57
#841
1992

NIST Special Publication 841

UNIFORMAT II—A Recommended Classification for Building Elements and Related Sitework

Brian Bowen
Hanscomb Associates Inc., Atlanta

Robert P. Charette
Le Groupe Hanscomb Inc., Montreal

and

Harold E. Marshall
Office of Applied Economics
Computing and Applied Mathematics Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899

Issued August 1992

U.S. DEPARTMENT OF COMMERCE
Barbara Hackman Franklin, *Secretary*
Technology Administration
Robert M. White, *Under Secretary for Technology*
National Institute of Standards and Technology
Johns W. Lyons, *Director*

National Institute of Standards
and Technology
Special Publication 841
Natl. Inst. Stand. Technol.
Spec. Publ. 841
51 pages (Aug. 1992)
CODEN: NSPUE2

U.S. Government Printing Office
Washington: 1991

For sale by the Superintendent
of Documents
U.S. Government Printing Office
Washington, DC 20402

Abstract

This report describes UNIFORMAT II, a format for classifying building elements and related sitework. Elements, as defined here, are major components common to most buildings. Elements usually perform a given function, regardless of the design specification, construction method, or materials used. Elements are also commonly referred to as systems or assemblies. Using UNIFORMAT II ensures consistency in the economic evaluation of building projects over time and from project to project, and it enhances reporting at all stages in construction--from feasibility and planning through the preparation of working documents, construction, maintenance, rehabilitation, and disposal. UNIFORMAT II is a significant advance over the original UNIFORMAT classification because the new version is the result of an intensive industry review and has added elements and expanded descriptions of many existing elements. Performing an economic analysis based on an elemental framework instead of on a product-based classification reduces the time and costs for evaluating alternatives at the design stage, and thereby encourages more economic analyses and more economically efficient choices among buildings and building elements. Collecting capital, operating, and maintenance costs according to UNIFORMAT II is an efficient approach to project evaluation using life-cycle cost, net benefits, rate-of-return, and payback analyses. Elements are classified in three hierarchical levels of definition. Level 1 identifies seven Major Group Elements, such as the Substructure, Shell, and Interiors. Level 2 further subdivides Level 1 into Group Elements. The Shell, for example, includes the Superstructure, Exterior Closure, and Roofing. Level 3 breaks the Group Elements further into Individual Elements. Exterior Closure, for example, includes Exterior Walls, Windows, and Exterior Doors. UNIFORMAT II produces additional benefits such as providing a format for collecting and analyzing historical data to use in estimating and budgeting future projects; providing a check list for the cost estimation process as well as the creativity/brainstorming phase of value engineering procedures; providing a basis for training in cost estimation; facilitating communications among members of a project team regarding costs and scope of work in each discipline; and establishing a database for automated cost estimating. Owners, developers, programmers, cost planners, schedulers, architects and engineers, operating and maintenance staff, manufacturers, specification writers, and educators will find the classification useful.

Preface

This is the sixth in a series of National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards, reports on recommended standards related to applying economic evaluation methods to building decisions.[1] The first four dealt with the theory and application of economic methods of analysis, including life-cycle costing, net benefits, benefit-to-cost and savings-to-investment ratios, internal rate of return, and payback. These reports were used as the bases for standard practices published by the American Society for Testing and Materials (ASTM). The fifth NIST report was a recommended guide that focused on techniques that account for uncertainty in project input values and techniques that measure the risk that a project will have a less favorable economic outcome than what is desired or expected. ASTM used it as the basis for a standard guide for selecting among techniques for handling uncertainty and risk in project evaluation.

This report differs from the earlier recommended practices and guides in that it recommends a standard classification of building elements. The purpose of the classification is to ensure consistency in the format used for the economic evaluation of building projects over time and from project to project, and to enhance reporting at all stages of building procurement--from feasibility and planning through the preparation of working documents, construction, maintenance, rehabilitation, and disposal.

This report supports an ongoing standards development activity by ASTM's Building Economics Subcommittee (E06.81) and is in response to requests from the building community for a standard classification based on building elements rather than building products or materials. The report will be used as the technical basis for the development of an ASTM standard classification for elements of buildings and related sitework. It complements the existing set of ASTM practices, guides, and adjuncts by providing a format for collecting and evaluating costs in the economic evaluation of buildings and building systems. It also provides a standard framework for other design and construction-related activities such as project descriptions and scheduling.

---

[1]The previous five reports are as follows: Harold E. Marshall, Techniques for Treating Uncertainty and Risk in the Economic Evaluation of Building Investments, National Institute of Standards and Technology Special Publication 757, September 1988; Rosalie T. Ruegg, Stephen R. Petersen, and Harold E. Marshall, Recommended Practice for Measuring Life-Cycle Costs of Buildings and Building Systems, National Bureau of Standards Interagency Report 80-2040, June 1980; Harold E. Marshall and Rosalie T. Ruegg, Recommended Practice for Measuring Benefit/Cost and Savings-to-Investment Ratios for Buildings and Building Systems, National Bureau of Standards Interagency Report 81-2397, November 1981; Harold E. Marshall, Recommended Practice for Measuring Net Benefits and Internal Rates of Return for Investments in Buildings and Building Systems, National Bureau of Standards Interagency Report 83-2657, October 1983; and Harold E. Marshall, Recommended Practice for Measuring Simple and Discounted Payback for Investments in Buildings and Building Systems, National Bureau of Standards Interagency Report 84-2850, March 1984.

Acknowledgments

Thanks are due to the ASTM members and others who participated in the development of an improved classification for building elements and thereby have helped determine the framework of this report. The industry-wide technical support from professional societies and the public and private sectors has contributed greatly to arriving at a consensus for this classification. Special appreciation for their contributions to the report is extended to Kenneth Humphreys, Executive Director of the American Association of Cost Engineers, Robert Johnson, past President of the Construction Specifications Institute, and Dana Smith, Director of the NAVFAC Engineering Systems Management Division and Chairman of the Tri-Services Work Breakdown Structure Subcommittee. Thanks are also due to Noel Raufaste and Stephen Weber of NIST for their technical review of the report, and to Laurene Linsenmayer for her typing of the manuscript. And finally, thanks are due to R. S. Means, Inc. for the cover art work.

Contents

Page

Abstract . . . iii

Preface . . . v

Acknowledgments . . . vii

1. Introduction . . . 1
   1.1 Background . . . 1
   1.2 Purpose and Benefits . . . 4
   1.3 Organization . . . 4

2. UNIFORMAT II Classification for Building Elements and Related Sitework . . . 7
   2.1 Framework of the Built Environment . . . 7
   2.2 Criteria for the Proposed Classification . . . 7
   2.3 Classification of Building Elements . . . 8
   2.4 Classification of Building-Related Sitework . . . 10

3. Description of Building Elements . . . 11
   3.1 Foundations . . . 11
      3.1.1 Standard Foundations . . . 11
      3.1.2 Special Foundations . . . 11
      3.1.3 Slab on Grade . . . 12
   3.2 Basement Construction . . . 12
      3.1.1 Basement Excavation . . . 12
      3.2.2 Basement Walls . . . 12
   3.3 Superstructure . . . 12
      3.3.1 Floor Construction . . . 12
      3.3.2 Roof Construction . . . 13
   3.4 Exterior Closure . . . 13
      3.4.1 Exterior Walls . . . 13
      3.4.2 Windows . . . 13
      3.4.3 Exterior Doors . . . 14
   3.5 Roofing . . . 14
      3.5.1 Roof Coverings . . . 14
      3.5.2 Roof Openings . . . 14
   3.6 Interior Construction . . . 15
      3.6.1 Partitions . . . 15
      3.6.2 Interior Doors . . . 15
      3.6.3 Specialties . . . 15
   3.7 Staircases . . . 16
      3.7.1 Stair Construction . . . 16
      3.7.2 Stair Finishes . . . 16
   3.8 Interior Finishes . . . 16
      3.8.1 Wall Finishes . . . 16
      3.8.2 Floor Finishes . . . 16
      3.8.3 Ceiling Finishes . . . 17

Contents (continued)

Page

3.9 Conveying Systems 17
3.9.1 Elevators 17
3.9.2 Escalators and Moving Walks 17
3.9.3 Material Handling Systems 17
3.10 Plumbing 18
3.10.1 Plumbing Fixtures 18
3.10.2 Domestic Water 18
3.10.3 Sanitary Waste 18
3.10.4 Rain Water Drainage 18
3.10.5 Special Plumbing Systems 19
3.11 HVAC 19
3.11.1 Energy Supply 19
3.11.2 Heat Generating Systems 19
3.11.3 Cooling Generating Systems 19
3.11.4 Distribution Systems 20
3.11.5 Terminal and Package Units 20
3.11.6 Controls and Instrumentation 21
3.11.7 Special HVAC Systems and Equipment 21
3.11.8 Systems Testing and Balancing 21
3.12 Fire Protection 21
3.12.1 Sprinkler Systems 21
3.12.2 Stand-Pipe Systems 21
3.12.3 Fire Extinguishers 22
3.12.4 Special Fire Protection 22
3.13 Electrical 22
3.13.1 Service and Distribution 22
3.13.2 Lighting and Branch Wiring 22
3.13.3 Communications and Security Systems 23
3.13.4 Special Electrical Systems 23
3.14 Equipment 23
3.15 Furnishings 23
3.16 Special Construction 24
3.17 Selective Building Demolition 24
3.17.1 Building Elements 24
3.17.2 Hazardous Components 24

4. Description of Building-Related Sitework 25
4.1 Site Preparation 25
4.1.1 Site Clearing 25
4.1.2 Site Demolition and Relocations 25
4.1.3 Site Earthwork 25
4.1.4 Hazardous Waste Remediation 25

Contents (continued)

Page

4.2 Site Improvement 25
4.2.1 Roadways 25
4.2.2 Parking Lots 26
4.2.3 Walks and Terraces 26
4.2.4 Site Development 26
4.2.5 Landscaping 26
4.3 Site Civil/Mechanical Utilities 27
4.3.1 Water Supply and Distribution Systems 27
4.3.2 Sanitary Sewer Systems 27
4.3.3 Storm Sewer Systems 27
4.3.4 Heating Distribution 27
4.3.5 Cooling Distribution 27
4.3.6 Gas Distribution System 28
4.3.7 Other Civil/Mechanical Utilities 28
4.4 Site Electrical Utilities 28
4.4.1 Electrical Distribution 28
4.4.2 Exterior Lighting 28
4.4.3 Exterior Communications and Security 28
4.4.4 Other Electric Utility Systems 28
4.5 Other Site Construction 29
4.5.1 Service Tunnels 29
4.5.2 Other Site Systems and Equipment 29

5. Applications and Limitations 31
5.1 Cross-Filing of Product Literature and Technical Guides 31
5.2 Building Performance Code Formats 31
5.3 Computer-Aided Design Reference Framework 32
5.4 Preliminary Project Descriptions 32
5.5 Construction and Operating and Maintenance Cost Databases 32
5.6 Planning and Feasibility Studies, and Space Programming 33
5.7 Estimating and Controlling Costs During Design and Construction 33
5.8 Economic Analysis 33
5.9 Risk Analysis 33
5.10 Value Engineering 34
5.11 Project Scheduling 34
5.12 Limitations 34

Contents (continued)

Page

6. Relationship to Other Formats 35
6.1 Elemental Formats 35
6.2 Product Formats 35

Appendix A Author Profiles 37

Appendix B CSI MASTERFORMAT Division Titles for Divisions 1-16 39

Appendix C CSI MASTERFORMAT Broadscope Section Titles for Divisions 11—Equipment, 12—Furnishings, and 13—Special Construction 41

Appendix D References 43

LIST OF CHARTS

Chart 1.1 Elemental Classifications 3

Chart 2.1 UNIFORMAT II Classification of Building Elements 8

Chart 2.2 UNIFORMAT II Classification of Building-Related Sitework 10

Chart 6.1 Relationship of UNIFORMAT to MASTERFORMAT 36

LIST OF FIGURES

Figure 2.1 Framework of the Built Environment 7

1. Introduction

1.1 Background

The building community needs a format or classification framework to serve as a consistent reference for analysis, evaluation, and monitoring of buildings during the planning, feasibility, and design stages.[2] An elemental building classification is one approach to meeting these objectives. Elements, as defined here, are major components common to most buildings. Elements usually perform a given function regardless of the design specification, construction method, or materials used. Examples of elements would be the Foundations, Exterior Walls, Sprinkler Systems, and Lighting. Elements are also commonly referred to as systems or assemblies in current practice.

Hanscomb Associates in the United States developed for the American Institute of Architects (AIA) in 1973 an elemental format called MASTERCOST. In conjunction with the General Services Administration (GSA), a consensus format named UNIFORMAT[3] was then produced. UNIFORMAT never gained "standard" status or Federal recognition as an official elemental classification. Yet, it usually forms the basis of any elemental format called for in the United States. The elemental classification proposed in this report for consideration as a standard is also based in part on the original UNIFORMAT. We call the recommended classification UNIFORMAT II to emphasize that it is an elemental classification similar to the original UNIFORMAT.

UNIFORMAT II provides some significant advances over UNIFORMAT.[4] UNIFORMAT II takes into consideration a broader range of building types than those considered by GSA, comments for improvement received from practitioners over the 16 years since UNIFORMAT's introduction, and a multi-disciplinary review from building professionals. Concurrent with the development of UNIFORMAT II, the three main United States Department of Defense agencies were working towards a coordination of their separate interpretations of UNIFORMAT. Their collaboration with the ASTM Subcommittee Task Group that is preparing the new standard classification was helpful in writing UNIFORMAT II in a way that is likely to achieve consensus in its acceptance as a standard.

The need for an elemental classification is most apparent in the economic evaluation of building alternatives at the design stage. One way of obtaining an estimate of the life-cycle costs of design alternatives is to perform detailed quantity takeoffs of all materials and tasks associated with the construction, operation, and maintenance of the buildings. MASTERFORMAT,[5] a classification that is based on products and materials, is a logical format choice when preparing detailed cost

---

[2]Buildings are the focus of this report, but they represent only one feature of the built environment, as shown in figure 2.1. The Construction Specifications Institute has pledged to expand the classifiction to accommodate other elements of the built environment.

[3]Hanscomb Associates Inc., Automated Cost Control & Estimating System, first ed. (Washington, DC: General Services Administration, 1975).

[4]Note that Brian Bowen, a co-author of this report, was the principle author of UNIFORMAT. See Appendix A for a short biographical description of the authors.

[5]The Construction Specifications Institute, MASTERFORMAT, 1988 edition (Alexandria, VA: CSI, 1988).

estimates. But a cost estimate prepared using a format based on a listing of products and materials is time consuming and inappropriate due to a lack of detailed design information when conducted at the early project stages. Yet, it is in the early stages that economic analysis is most important in establishing the economically efficient choices among building alternatives. Only an elemental-based format readily provides the necessary cost information for the analyst to evaluate building alternatives in a cost-effective manner.

Users of building classification formats recognize that both elemental and detailed product formats have their applications and can be complementary. Uman[6] states that "Both estimating formats should be formalized into estimating standards for the building design and construction industry: MASTERFORMAT for design manuals and construction estimating, and UNIFORMAT for building design and construction cost comparison and analysis." Johnson[7] predicts that "UNIFORMAT will become the official consensus elemental and systems-based format that will be widely used in the construction industry..." and that "UNIFORMAT will not be considered a competitor to MASTERFORMAT, but rather as a companion format where each has its appropriate uses."

Elemental formats have emerged in other countries in the search for a better format to help perform economic analyses of building projects. British quantity surveyors first developed an elemental format after World War II while helping the Department of Education develop a cost planning approach in rebuilding and expanding the British school system. This led to the Royal Institute of Chartered Surveyors (RICS) publishing a standard list of elements[8] in 1969 that the building community uses routinely in the United Kingdom. As quantity surveyors who trained in Britain performed their jobs around the world, they carried the elemental format with them. By 1972, the Canadian Institute of Quantity Surveyors endorsed its own standard classification of elements for buildings[9] which was subsequently adopted by the Royal Architectural Institute of Canada (RAIC). Today the United Kingdom, Belgium, Germany, France, Ireland, Switzerland, Belgium, Denmark, South Africa, Japan, the Netherlands, Hong Kong, and many of the former British colonies have an elemental classification system. The pervasiveness and need for the elemental system has encouraged the International Council for Building Research Studies and Documentation (CIB) and the Construction Economics European Committee (CEEC) to establish an elemental format to collect costs for international exchange. A major objective of the CEEC format is to make it compatible with the existing formats of as many countries as possible.

Chart 1.1 summarizes the four elemental classifications referred to earlier--UNIFORMAT, sponsored by GSA, variants of which are used informally in the United States; the Canadian (CIQS) standard;

---

[6]Daniel M. Uman, "Is a Standard Needed for Estimating Building Design and Construction Cost?" Cost Engineering, Vol. 32, No. 8, August 1990, p. 10.

[7]Robert W. Johnson, AIA "Trends in Formats," The Construction Specifier, June 1991, p. 94.

[8]Royal Institute of Chartered Surveyors, Standard Form of Cost Analysis (London, England: The Building Cost Information Service, 1969 (Reprinted December 1987)).

[9]Canadian Institute of Quantity Surveyors, Elemental Cost Analysis--Method of Measurement and Pricing (Toronto, Ontario, Canada: Canadian Institute of Quantity Surveyors, first issued 1972, revised 1990).

UNIFORMAT General Services Administration (GSA)	CANADIAN INSTITUTE OF QUANTITY SURVEYORS (CIQS)	THE ROYAL INSTITUTION OF CHARTERED SURVEYORS (RICS-UK)	CONSTRUCTION ECONOMICS EUROPEAN COMMITTEE (CEEC)
01 FOUNDATIONS	1.0 SUBSTRUCTURE	1.0 SUBSTRUCTURE	(1) SUBSTRUCTURE
011 Standard foundations	a. Normal foundation	2.0 SUPERSTRUCTURE	SUPERSTRUCTURE
012 Special foundations	b. Basement excavation & backfill	2.1 Frame	(2) Frame
02 SUBSTRUCTURE	c. Special foundations	2.2 Upper floors	(3) External walls
021 Slab on grade	2.0 STRUCTURE	2.3 Roof	(4) Internal walls
022 Basement excavation	a. Lowest floor construction	2.4 Stairs	(5) Floors
023 Basement walls	b. Upper floor construction	2.5 External walls	(6) Roofs
03 SUPERSTRUCTURE	c. Roof construction	2.6 Windows & exterior doors	(7) Stairs
031 Floor construction	3.0 EXTERIOR CLADDING	2.7 Interior walls & interior partitions	(8) Windows & extl. doors
032 Roof construction	a. Roof finishes	2.8 Interior doors	(9) Internal doors
033 Stair construction	b. Walls below ground floor	3.0 INTERNAL FINISHES	FINISHES
04 EXTERIOR CLOSURE	c. Walls above ground floor	3.1 Wall finishes	(10) Internal wall finishes
041 Exterior walls	d. Windows	3.2 Floor finishes	(11) External wall finishes
042 Exterior doors & windows	e. Exterior doors & screens	3.3 Ceiling finishes	(12) Floor finishes
05 ROOFING	4.0 INTERIOR PARTITIONS AND DOORS	4.0 FITTINGS AND FURNITURE	(13) Ceiling finishes
06 INTERIOR CONSTRUCTION	a. Permanent partitions & doors	4.1 Fittings and furnishings	(14) EQUIPMENT & FURNISHINGS
061 Partitions	b. Movable partitions & doors	5.0 SERVICES	SERVICES
062 Interior finishes	5.0 VERTICAL MOVEMENT	5.1 Sanitary appliances	(15) Plumbing
063 Specialties	a. Stairs	5.2 Services equipment	(16) Heating
07 CONVEYING SYSTEMS	b. Elevators and escalators	5.3 Disposal installations	(17) Ventilating & air-conditioning
08 MECHANICAL	6.0 INTERIOR FINISHES	5.4 Water installations	(18) Internal drainage
081 Plumbing	a. Floor finishes	5.5 Heat source	(19) Electrics
082 HVAC	b. Ceiling finishes	5.6 Space heating & air treatment	(20) Communication
083 Fire protection	c. Wall finishes	5.7 Ventilation systems	(21) Lifts, escalators, etc.
084 Special mechanical systems	7.0 FITTINGS AND EQUIPMENT	5.8 Electrical installation	(22) Protective installations
09 ELECTRICAL	a. Fittings & fixtures	5.9 Gas installation	(23) Miscellaneous services inst.
091 Distribution	b. Equipment	5.10 Life & conveyor installation	EXTERNAL SITE WORKS
092 Lighting & power	8.0 SERVICES	5.11 Protective installations	(24) Site preparation
093 Special electrical systems	a. Electrical	5.12 Communication installations	(25) Site enclosure
10 GENERAL CONDITIONS & PROFIT	b. Plumbing & drainage	5.13 Special installations	(26) Site fittings
11 EQUIPMENT	c. Heating, ventilation & air-conditioning	5.14 Builders work in connection with services	(27) Site services
111 Fixed & movable equipment	9.0 SITE DEVELOPMENT	5.15 Builders profit & attendance on services	(28) Site buildings
112 Furnishings	a. General	6.0 EXTERNAL WORKS	(29) Hard and soft landscaping
113 Special construction	b. Services	6.1 Site works	(30) PRELIMINARIES
12 SITE WORK	c. Alterations	6.2 Drainage	
121 Site preparation	d. Demolition	6.3 External services	
122 Site improvements	10.0 OVERHEAD AND PROFIT	6.4 Minor building work	
123 Site utilities	a. Site overhead		
124 Off-site work	b. Head office overhead and profit		

Chart 1.1 Elemental Classifications

Bowen, B. and Charette, R. P., "Elemental Cost Classification Standard for Building Design," 1991 American Association of Cost Engineers (AACE) Transactions, Seattle, WA.

the United Kingdom (RICS) standard; and the European CEEC standard for data exchange. Developing a true standard classification for the United States will facilitate commerce and data exchange within the United States and throughout the international building community.

1.2 Purpose and Benefits

The purpose of this report is to provide a classification for building elements and related sitework. Using a standard classification will help ensure consistency in the economic evaluation of building projects over time and from project to project. It will also enhance reporting at all stages of building procurement--from feasibility and planning through the preparation of working documents, construction, maintenance, rehabilitation, and disposal.

Specifically, using a standard classification will lead to more cost-effective design decisions. This will result from being able to perform more quickly, and at less cost, economic evaluations of project alternatives at the design or even pre-design stage. Without an elemental format to facilitate effective cost analysis, fewer design alternatives will be considered at the early stages, and project alternatives with minimum life-cycle costs may never be considered. With the elemental format, analysts can follow a hierarchical approach for successive design phases. This helps ensure that design alternatives from concepts and systems to products and materials are considered at the appropriate time, thus increasing the probability of selecting the most cost-effective designs.

Additional benefits include providing a format for collecting and analyzing historical data to use in estimating and budgeting future projects; providing a check list for the cost estimation process and the creativity phase of value engineering; providing a basis for training in cost estimation; facilitating communications among members of a project team regarding costs; establishing a database for automated cost estimating; and facilitating the preparation of estimates without having to select products and materials.

The American Society for Testing and Materials (ASTM) has published standard practices on net benefits, rate-of-return, life-cycle cost, benefit-to-cost ratio, and payback analyses for evaluating building alternatives at the design and later stages of project development. Applying these measures of building performance in a cost-effective manner early in the process requires a standard format for organizing costs that is less detailed than existing formats based on materials. This report is to be the technical basis for developing an ASTM standard classification based on building elements rather than building materials.[10] It will complement the existing set of ASTM practices, guides, and adjuncts by providing a format for collecting and evaluating alternative design data and costs in the economic evaluation of buildings and building elements.

1.3 Organization

Chapter 2 presents UNIFORMAT II in chart form, complete to three hierarchical levels, for both building elements and related sitework. (These charts also appear, for quick reference, on the inside

[10]For a discussion of why ASTM is developing a standard classification and how it is being done, see Brian Bowen and Robert Charette, "Elemental Cost Classification Standard for Building Design," 1991 AACE Transactions, 1991.

of the front and back covers.) The chapter describes the criteria used to determine which categories of elements to include and in what classification to include them. The chapter also presents a general framework of the built environment to provide perspective as to how the buildings and related sitework, that UNIFORMAT II covers, fit in with the total built environment.

Chapter 3 lists specific elements/items that are included and excluded under each individual element listed in the Level 3 category for the classification of building elements. Providing a cross-reference to the appropriate element beside each item in the excluded list helps users of UNIFORMAT II find the classification category more quickly.

Chapter 4 lists specific elements/items that are included and excluded under each individual element listed in the Level 3 category for the classification of building-related sitework.

2. UNIFORMAT II Classification for Building Elements and Related Sitework

2.1 Framework of the Built Environment

The framework in figure 2.1 shows how buildings and related sitework fit in with the rest of the built environment. This report describes exclusively the elements that make up the blocks shaded under the "buildings" block, i.e., construction of buildings and related sitework. UNIFORMAT II does not treat other aspects of buildings or other features of the built environment, which are indicated by the non-shaded blocks.

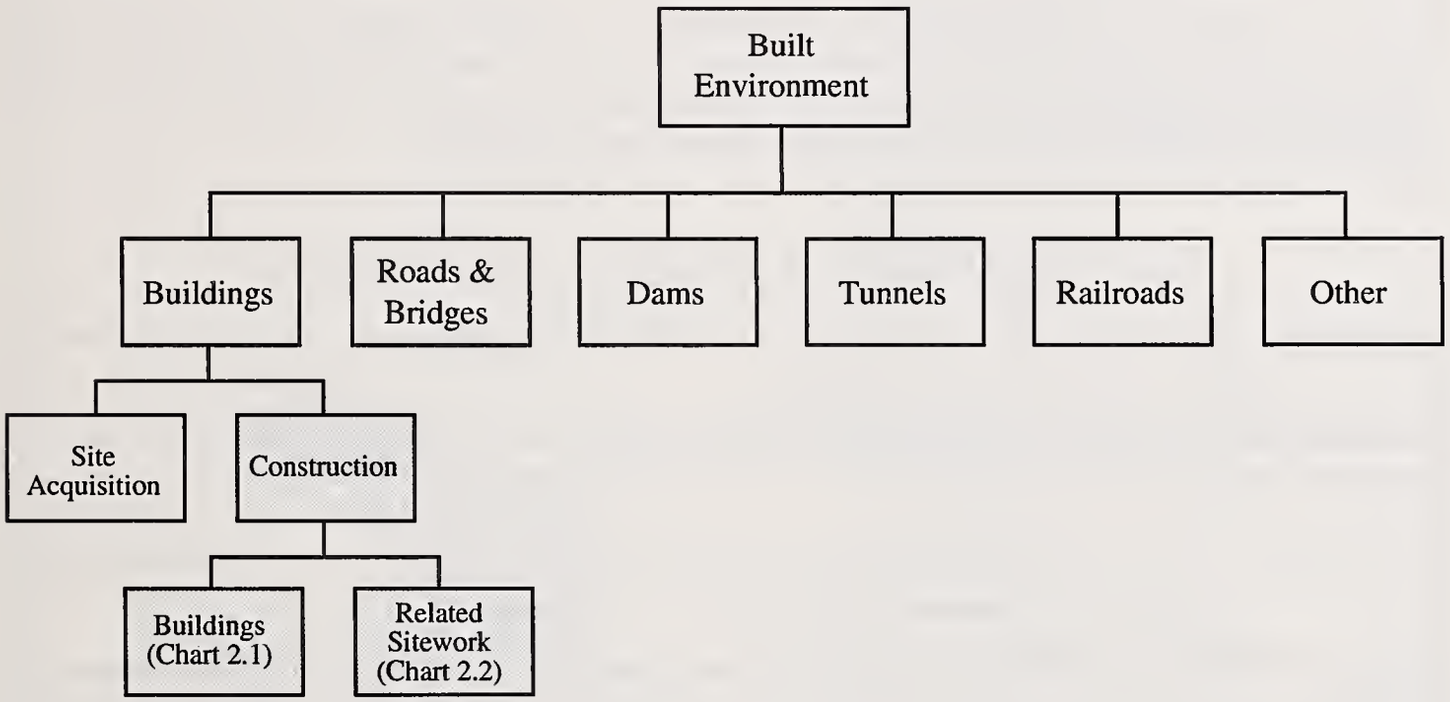


Figure 2.1 Framework of the Built Environment

2.2 Criteria for the Proposed Classification

We used the following criteria in deciding on the appropriate classification, what items to include in it, and in which parts of the classification to include them.

The appropriate classification will be applicable to any building type, while at the same time allowing for details desirable for specialized buildings. The classification of building elements will be separate from the classification of building-related sitework. The classifications will be hierarchical to allow different levels of aggregation and summarization. And they will relate to other elemental classifications such as UNIFORMAT and the classification of the Canadian Institute of Quantity Surveyors.

Items to be included in the classification will have significant influence on cost and a high frequency of occurrence. Categories will be defined so as to provide a framework for cost control. The decision as to where among the classification elements to include specific items is to rely on professional judgment as to where building professionals in current practice normally look for such items.

2.3 Classification of Building Elements

Chart 2.1 presents the UNIFORMAT II classification of building elements. It comprises three hierarchical levels: Major Group Elements for Level 1, Group Elements for Level 2, and Individual Elements for Level 3. See Chapter 3 for detailed lists of specific items that are included and excluded under each individual element listed in the Level 3 category.

Chart 2.1 UNIFORMAT II Classification of Building Elements

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
SUBSTRUCTURE	Foundations	Standard Foundations Special Foundations Slab on Grade
	Basement Construction	Basement Excavation Basement Walls
SHELL	Superstructure	Floor Construction Roof Construction
	Exterior Closure	Exterior Walls Windows Exterior Doors
	Roofing	Roof Coverings Roof Openings
INTERIORS	Interior Construction	Partitions Interior Doors Specialties
	Staircases	Stair Construction Stair Finishes
	Interior Finishes	Wall Finishes Floor Finishes Ceiling Finishes

Chart 2.1 UNIFORMAT II Classification of Building Elements (continued)

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
SERVICES	Conveying Systems	Elevators Escalators & Moving Walks Material Handling Systems
	Plumbing	Plumbing Fixtures Domestic Water Sanitary Waste Rain Water Drainage Special Plumbing Systems
	HVAC	Energy Supply Heat Generating Systems Cooling Generating Systems Distribution Systems Terminal & Package Units
		Controls & Instrumentation Special HVAC Systems & Equipment Systems Testing & Balancing
	Fire Protection	Sprinkler Systems Stand-Pipe Systems Fire Extinguishers Special Fire Protection
	Electrical	Service & Distribution Lighting & Branch Wiring Communication & Security Systems Special Electrical Systems
EQUIPMENT & FURNISHINGS	Equipment	User defined elements using CSI MASTERFORMAT Division 11--Equipment
	Furnishings	User defined elements using CSI MASTERFORMAT 12--Furnishings
SPECIAL CONSTRUCTION & DEMOLITION	Special Construction	User defined elements using CSI MASTERFORMAT 13--Special Construction
	Selective Building Demolition	Building Elements Hazardous Components

2.4 Classification of Building-Related Sitework

Chart 2.2 presents the UNIFORMAT II classification of building-related sitework. See Chapter 4 for detailed lists of specific items that are included and excluded under each individual element listed in the Level 3 category.

Note that UNIFORMAT II is not intended to classify elements of major civil works. Rather, it is provided for exclusive use in support of the construction of buildings. Buildings are usually constructed with roads, utilities, parking areas, and other non-building features. The UNIFORMAT II classification of building-related sitework provides guidance so that planners do not have to resort to multiple elemental classifications for one project.

Chart 2.2 UNIFORMAT II Classification of Building-Related Sitework

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
BUILDING SITEWORK	Site Preparation	Site Clearing Site Demolition and Relocations Site Earthwork Hazardous Waste Remediation
	Site Improvements	Roadways Parking Lots Walks & Terraces Site Development Landscaping
	Site Civil/Mechanical Utilities	Water Supply & Distribution Systems Sanitary Sewer Systems Storm Sewer Systems Heating Distribution Cooling Distribution
		Gas Distribution System Other Civil/Mechanical Utilities
	Site Electrical Utilities	Electrical Distribution Exterior Lighting Exterior Communications & Security Other Electrical Utilities
	Other Site Construction	Service Tunnels Other Site Systems & Equipment

3. Description of Building Elements

The following lists show what items are included and excluded in the recommended classification at Level 3. Note that the listings of inclusions and exclusions are not intended to be an exhaustive listing. Rather, they provide a general outline of what to expect in that element consistent with the selection criteria outlined in section 2.2. We list exclusions to help readers find items quickly. For example, exterior load bearing walls could be under Exterior Walls or Superstructure. We put them under Exterior Walls based on technical judgment and current practice. Putting under Superstructure a cross-reference to Exterior Walls directs the person who looks first under Superstructure to the appropriate element.

Note, also, that the numbering system is only for the purpose of organizing the report. The numbers are not classification numbers for the elements. They are yet to be determined.

3.1 Foundations

3.1.1 Standard Foundations

Includes

- wall & column foundations
- foundation walls up to level of top of slab on grade
- pile caps
- backfill & compaction
- footings & bases
- perimeter & under-slab insulation
- perimeter drainage
- anchor plates

Excludes

- general excavation to reduce levels (see section 4.1.3, Site Earthwork)
- excavation for basements (see section 3.2.1, Basement Excavation)
- basement walls (see section 3.2.2, Basement Walls)
- under-slab drainage (see section 3.1.3, Slab on Grade)

3.1.2 Special Foundations

Includes

- piling
- caissons
- underpinning
- dewatering
- raft foundations
- any other special foundation conditions

Excludes

- pile caps (see section 3.1.1, Standard Foundations)
- rock excavation (unless associated with Special Foundations) (see section 3.1.1, Standard Foundations & section 3.2.1, Basement Excavation)

3.1.3 Slab on Grade

Includes

- standard
- structural
- inclined slabs on grade
- trenches
- pits
- bases
- under-slab drainage

Excludes

- applied floor finishes (see section 3.8.2, Floor Finishes)
- hardeners & sealers to the slab (see section 3.8.2, Floor Finishes)

3.2 Basement Construction

3.2.1 Basement Excavation

Includes

- additional excavation required for construction of basement
- backfill & compaction
- shoring

Excludes

- general grading to reduce levels over site (see section 4.1.3, Site Earthwork)

3.2.2 Basement Walls

Includes

- basement wall construction
- moisture protection
- basement wall construction below grade

Excludes

- walls above grade that enclose basements (see section 3.4.1, Exterior Walls)
- perimeter drainage (see section 3.1.1, Standard Foundations)

3.3 Superstructure

3.3.1 Floor Construction

Includes

- structural frame
- interior structural walls
- floor slabs & decks
- inclined & stepped floors
- expansion & contraction joints
- balcony construction
- suspended ramps
- special floor construction (e.g., catwalks, space frames, etc.)

Excludes

- exterior load bearing walls (see section 3.4.1, Exterior Walls)
- applied & suspended ceiling & floor finishes (see section 3.8.2, Floor Finishes & section 3.8.3, Ceiling Finishes)
- stair construction (see section 3.7.1, Stair Construction)
- balcony walls & railings (see section 3.4.1, Exterior Walls)

3.3.2 Roof Construction

Includes

- structural frame
- structural interior walls supporting roof
- roof decks, slabs & sheathing
- canopies
- special roof systems

Excludes

- roof coverings (see section 3.5.1, Roof Coverings)
- skylights & roof openings (see section 3.5.2, Roof Openings)
- stair construction (see section 3.7.1, Stair Construction)

3.4 Exterior Closure

3.4.1 Exterior Walls

Includes

- exterior wall construction with facing materials, exterior applied finishes, back-up construction, framing, wallboard, parapets, insulation & vapor barriers
- exterior load-bearing wall construction
- exterior louvers & screens
- exterior sun control devices
- balcony walls & railings
- exterior soffits

Excludes

- applied finishes to interior faces of exterior walls (see section 3.8.1, Wall Finishes)
- columns and beams in exterior walls (see section 3.3, Superstructure)
- venetian blinds (see section 3.15, Furnishings)
- other interior sun control devices (see section 3.15, Furnishings)
- roof eaves and eaves soffits (see section 3.5.1, Roof Coverings)
- glazed curtain walls (see section 3.4.2, Windows)

3.4.2 Windows

Includes

- windows
- storefronts
- curtain walls
- exterior painting to windows
- wall opening elements such as lintels, sills, flashings, etc.

Excludes

- window treatments (see section 3.15, Furnishings)

3.4.3 Exterior Doors

Includes

- personnel doors
- revolving doors
- overhead doors
- special doors (e.g., hanger doors, blast-resistant doors, etc.)

3.5 Roofing

3.5.1 Roof Coverings

Includes

- roofing membranes
- traffic coatings
- waterproof membranes below paving
- expansion joints
- vapor barriers
- roof & deck insulation
- roof fill
- flashings & trim
- gutters & downspouts
- eaves & eaves soffits

Excludes

- roof openings (see section 3.5.2, Roof Openings)
- roof drains (see section 3.10.4, Rain Water Drainage)
- parapets (see section 3.4.1, Exterior Walls)

3.5.2 Roof Openings

Includes

- skylights
- area glazing
- roof hatches
- gravity roof ventilators
- smoke vents

Excludes

- powered & ducted ventilators (see section 3.11.4, Distribution Systems)

3.6 Interior Construction

3.6.1 Partitions

Includes

- fixed partitions
- demountable partitions
- toilet partitions
- retractable & movable partitions
- operable partitions
- compartments & cubicles
- interior balustrades & screens
- interior window & storefronts

Excludes

- stair balustrades (see section 3.7.2, Stair Finishes)
- interior load bearing & shear walls (see section 3.3, Superstructure)
- applied wall finishes (see section 3.8.1, Wall Finishes)

3.6.2 Interior Doors

Includes

- standard doors
- glazed doors
- sliding & folding doors
- fire doors
- special doors
- door frames
- door hardware
- door opening elements
- door painting & staining
- hatches & access doors

Excludes

- vault doors (see section 3.14, Equipment)
- operable partitions (see section 3.6.1, Partitions)

3.6.3 Specialties

Includes

- chalk & tack boards
- identifying devices
- lockers
- toilet & bath accessories
- storage shelving
- miscellaneous metal work
- built-in counters & vanities
- kitchen cabinets
- closets

Excludes

- special equipment (see section 3.14, Equipment)
- furniture (see section 3.15, Furnishings)
- special construction (see section 3.16, Special Construction)
- compartments & cubicles (see section 3.6.1, Partitions)
- fire extinguishers (see section 3.12.3, Fire Extinguishers)
- manufactured case work (see section 3.15, Furnishings)

3.7 Staircases

3.7.1 Stair Construction

Includes
- stair structure

Excludes
- steps in structural slabs (see section 3.3.1, Floor Construction)

3.7.2 Stair Finishes

Includes
- finishes to treads, risers, landings, & soffits
- handrails & balustrades

3.8 Interior Finishes

3.8.1 Wall Finishes

Includes
- concrete wall finishes
- wall plastering
- wallboard
- tile & terrazzo
- painting
- wallcoverings
- acoustic tiles
- special coatings & finishings

Excludes
- wallboard applied to interior walls & partitions (see section 3.6.1, Partitions)

3.8.2 Floor Finishes

Includes
- screeds & toppings
- hardeners & sealers
- tile, terrazzo, wood & resilient flooring
- carpeting
- masonry & stone flooring
- special flooring (e.g., conductive, armored)
- painting & staining
- access pedestal flooring

Excludes
- stair finishes (see section 3.7.2, Stair Finishes)

3.8.3 Ceiling Finishes

Includes
- exposed concrete finishes
- plaster ceiling finishes
- wallboard ceiling finishes
- acoustic ceiling tiles & panels
- painting & staining
- metal strip ceilings
- special ceilings
- all suspended systems

Excludes
- finishes to stair soffits (see section 3.7.2, Stair Finishes)
- finishes to exterior soffits (see section 3.4.1, Exterior Walls)

3.9 Conveying Systems

3.9.1 Elevators

Includes
- passenger elevators
- freight elevators
- general construction items associated with elevators

Excludes
- elevator pits (see section 3.1.3, Slab on Grade)

3.9.2 Escalators and Moving Walks

Includes
- escalators
- moving walks
- balustrades

3.9.3 Material Handling Systems

Includes
- hoist & cranes
- conveyors
- dumbwaiters
- pneumatic tube systems
- linen, trash & mail chutes
- turntables

3.10 Plumbing

3.10.1 Plumbing Fixtures

Includes

- waterclosets
- urinals
- lavatories
- sinks
- showers
- bathtubs
- drinking fountains
- bidets

Excludes

- domestic hot water heaters (see section 3.10.2, Domestic Water)
- hose bibs (see section 3.10.2, Domestic Water)
- special equipment (see section 3.10.5, Special Plumbing Systems)

3.10.2 Domestic Water

Includes

- pipes & fittings
- valves, hydrants & hose bibs
- hot water heaters
- domestic water supply equipment
- insulation

Excludes

- plumbing fixtures (see section 3.10.1, Plumbing Fixtures)

3.10.3 Sanitary Waste

Includes

- wastepipe & fittings
- vent pipe & fittings
- floor drains
- sanitary waste equipment
- insulation

3.10.4 Rain Water Drainage

Includes

- pipe & fittings
- roof drains
- roof drainage equipment
- insulation

Excludes

- gutters & downspouts (see section 3.5.1, Roof Coverings)

3.10.5 Special Plumbing Systems

Includes

- special piping systems
- gas distribution
- acid waste systems
- interceptors
- pool equipment
- fountain piping systems & devices
- special plumbing fixtures

3.11 HVAC

3.11.1 Energy Supply

Includes

- oil, gas, & coal supply
- steam, hot & chilled water supply
- solar energy supply
- wind energy supply

Excludes

- electrical energy supply systems (see section 3.13.4, Special Electrical Systems, and section 3.13.1, Service & Distribution)

3.11.2 Heat Generating Systems

Includes

- boilers, including electric
- piping and fittings adjacent to boilers
- primary pumps
- auxiliary equipment
- equipment & piping insulation

Excludes

- electric space unit heaters & baseboard, fuel fired unit heaters, furnaces (see section 3.11.5, Terminal & Package Units)
- controls & instrumentation (see section 3.11.6, Controls & Instrumentation)

3.11.3 Cooling Generating Systems

Includes

- chillers
- cooling towers & evaporative coolers
- condensing units
- piping & fittings
- primary pumps
- direct expansion systems
- equipment & piping insulation

Excludes

- secondary chilled water pumps (see section 3.11.4, Distribution Systems)
- distribution piping (see section 3.11.4, Distribution Systems)
- controls & instrumentation (see section 3.11.6, Controls & Instrumentation)

3.11.4 Distribution Systems

Includes

- supply & return air systems, including air handling units with coils (electric included), filters, ductwork, & associated devices such as VAV boxes, duct heaters, induction units & grilles
- ventilation & exhaust systems
- steam, hot water, glycol & chilled water distribution
- associated terminal devices including convectors, fan-coil units, & induction units, but not water & steam unit heaters
- heat recovery equipment
- auxiliary equipment such as secondary pumps, heat exchangers, sound attenuation, & vibration isolation
- piping, duct, & equipment insulation

Excludes

- electric, gas, or oil fired unit heaters (see section 3.11.5, Terminal & Package Units)
- furnaces (gas or oil) (see section 3.11.5, Terminal & Package Units)
- floor, ceiling, & rooftop package units (see section 3.11.5, Terminal & Package Units)
- controls & instrumentation (see section 3.11.6, Controls & Instrumentation)

3.11.5 Terminal and Package Units

Includes

- electric baseboard
- electric or fossil fuel fired unit heaters, unit ventilators, & radiant heaters
- window or through-the-wall air conditioners, with or without heating of any type
- reverse-cycle, water- or air-cooled, terminal heat pumps
- wall sleeves where required
- electric or fossil fuel fired air-handling units or furnaces
- self-contained, air- or water-cooled, floor, ceiling, & rooftop air conditioners, & heat pumps
- ductwork and accessories, including flue stacks
- factory-integrated controls

Excludes

- piping & accessories (see section 3.11.4, Distribution Systems)
- hydronic or steam convectors, fan-coil units (see section 3.11.4, Distribution Systems)
- cooling towers, remote air-cooled condensers, evaporative coolers (see section 3.11.3, Cooling Generation Systems)
- air-handling units with only hydronic heating or steam coils (see section 3.11.4, Distribution Systems)
- air-handling units with chilled water or direct expansion cooling coils (see section 3.11.4, Distribution Systems)

3.11.6 Controls and Instrumentation

For

- heating generating systems
- cooling generating systems
- heating/cooling air handling units
- exhaust & ventilating systems
- terminal devices
- energy monitoring & control
- building automation systems

Excludes

- factory-installed controls, when an integral part of terminal & package units (see section 3.11.5, Terminal & Package Units)

3.11.7 Special HVAC Systems and Equipment

Includes

- special cooling systems and devices
- special humidity control
- dust and fume collectors
- air curtains
- air purifiers
- paint spray booth ventilation systems
- general construction items associated with mechanical systems

3.11.8 Systems Testing and Balancing

Includes

- piping systems testing & balancing
- air systems testing & balancing

3.12 Fire Protection

3.12.1 Sprinkler Systems

Includes

- water supply equipment
- piping valves & fittings
- sprinkler heads & release devices

3.12.2 Stand-Pipe Systems

Includes

- water supply equipment
- piping valves & fittings
- cabinets & hoses

3.12.3 Fire Extinguishers

Includes
- fire extinguishers
- fire extinguisher cabinets

3.12.4 Special Fire Protection

Includes
- carbon dioxide systems
- halon systems
- foam generating systems
- chemical systems
- exhaust hood systems

3.13 Electrical

3.13.1 Service and Distribution

Includes
- primary transformers
- secondary transformers
- main switchboard
- interior distribution transformers
- branch circuit panels
- enclosed circuit breakers
- motor control centers
- conduit and wiring to circuit panels

Excludes
- outdoor transformers (see section 4.4.1, Electrical Distribution)
- emergency power (see section 3.13.4, Special Electrical Systems)
- branch wiring (see section 3.13.2, Lighting & Branch Wiring)

3.13.2 Lighting and Branch Wiring

Includes
- branch wiring & devices for lighting fixtures
- lighting fixtures
- branch wiring for devices & equipment connections
- devices

Excludes
- underfloor raceways (see section 3.13.4, Special Electrical Systems)
- exterior lighting (see section 4.4.2, Exterior Lighting)

3.13.3 Communications and Security Systems

Includes

- fire alarm systems
- hospital systems
- telephone systems
- local area networks
- public address & music systems
- intercommunication systems & paging
- clock & program systems
- television systems
- security systems

Excludes

- special electrical systems (see section 3.13.4, Special Electrical Systems)

3.13.4 Special Electrical Systems

Includes

- emergency generators
- UPS
- emergency lighting systems
- power factor correction
- lightning & grounding protection systems
- raceway systems

Excludes

- electric baseboard (see section 3.11.5, Terminal & Package Units)
- electric coils & duct heaters (see section 3.11.4, Distribution Systems)
- building automation & energy monitoring systems (see section 3.11.6, Controls & Instrumentation)
- communications & security systems (see section 3.13.3, Communications & Security Systems)

3.14 Equipment

Includes

All building-related items normally specified in CSI MASTERFORMAT Division 11--Equipment (see Appendix C for current listing of Equipment in MASTERFORMAT).

3.15 Furnishings

Includes

All building-related items normally specified in CSI MASTERFORMAT Division 12--Furnishings (see Appendix C for current listing of Furnishings in MASTERFORMAT).

3.16 Special Construction

Includes	Excludes
All building-related items normally specified in CSI MASTERFORMAT Division 13--Special Construction (see Appendix C for current listing of Special Construction in MASTERFORMAT).	• solar & wind energy supply (see section 3.11.1, Energy Supply)

3.17 Selective Building Demolition

3.17.1 Building Elements

Includes	Excludes
• demolition of existing building components	• site demolition (see section 4.1.2, Site Demolition & Relocations)

3.17.2 Hazardous Components

Includes
• removal or encapsulation of hazardous building materials & components

4. Description of Building-Related Sitework

The following lists show what components and procedures are included and excluded in the sitework classification at Level 3. Note again that the numbers are for the purpose of organizing the report and are not classification numbers for the elements.

4.1 Site Preparation

4.1.1 Site Clearing

Includes

- clearing & grubbing
- tree removal & thinning

4.1.2 Site Demolition and Relocations

Includes

- complete building demolition
- demolition of site components
- relocation of buildings & utilities

Excludes

- selective demolition within building (see section 3.17, Selective Building Demolition)

4.1.3 Site Earthwork

Includes

- grading, excavating & fill to modify site contours
- soil stabilization & treatment
- site watering
- site shoring
- embankments

Excludes

- building excavation for foundations and basements (see section 3.1, Foundations & section 3.2, Basement Construction)

4.1.4 Hazardous Waste Remediation

Includes

- removal & restoration of contaminated soil

4.2 Site Improvement

4.2.1 Roadways

Includes

- paving sub-base
- paving & surfacing
- curbs & gutters
- rails & barriers
- painted lines
- markings & signage

4.2.2 Parking Lots

Includes

- parking lot paving & surfacing
- curbs, rails & barriers
- parking booths & equipment
- markings & signage

4.2.3 Walks and Terraces

Includes

- paving & surfacing
- exterior steps

Excludes

- waterproof membranes under terrace & plaza paving (see section 3.5.1, Roof Coverings)

4.2.4 Site Development

Includes

- fences & gates
- retaining walls
- terrace & perimeter walls
- signs
- site furnishings
- fountains, pools, & watercourses
- playing fields
- flagpoles
- miscellaneous structures

Excludes

- signs (see section 4.2.1, Roadways & section 4.2.2, Parking Lots)

4.2.5 Landscaping

Includes

- fine grading & soil preparation
- top soil & planting beds
- seeding & sodding
- planting
- planters
- special landscape features
- irrigation systems

Excludes

- interior planters & planting (see section 3.15, Furnishings)
- site grading (see section 4.1.3, Site Earthwork)

4.3 Site Civil/Mechanical Utilities

4.3.1 Water Supply and Distribution Systems

Includes
- potable & non-potable water systems
- well systems
- fire protection systems
- pumping stations
- water storage

Excludes
- irrigation systems (see section 4.2.5, Landscaping)

4.3.2 Sanitary Sewer Systems

Includes
- piping
- manholes
- septic tanks
- lift stations
- package waste water treatment plants

4.3.3 Storm Sewer Systems

Includes
- piping
- manholes
- catch basins
- lift stations
- retention ponds
- ditches & culverts

4.3.4 Heating Distribution

Includes
- steam supply
- condensate return
- hot water supply systems

Excludes
- service tunnels (see section 4.5.1, Service Tunnels)

4.3.5 Cooling Distribution

Includes
- chilled water piping
- wells for cooling
- pumping stations
- cooling towers on site

Excludes
- service tunnels (see section 4.5.1, Service Tunnels)

4.3.6 Gas Distribution System

Includes

- gas piping
- equipment
- storage tanks

4.3.7 Other Civil/Mechanical Utilities

Includes

- industrial waste systems
- POL (Petroleum Oil & Lubricants) distribution systems

4.4 Site Electrical Utilities

4.4.1 Electrical Distribution

Includes

- substations
- overhead power distribution
- underground power distribution
- ductbanks
- grounding

4.4.2 Exterior Lighting

Includes

- fixtures & transformers
- poles
- wiring conduits & ductbanks
- controls
- grounding

4.4.3 Exterior Communications and Security

Includes

- overhead & underground communications
- site security & alarm systems
- ductbanks
- grounding

4.4.4 Other Electrical Utility Systems

Includes

- cathodic protection
- emergency power generation

4.5 Other Site Construction

4.5.1 Service Tunnels

Includes

- constructed service tunnels
- prefabricated service tunnels & trench boxes

4.5.2 Other Site Systems and Equipment

Includes

- snow melting systems
- pedestrian tunnels

5. Applications and Limitations

UNIFORMAT II applies to buildings and related sitework. It excludes specialized process equipment related to a building's functional use, but does include equipment and furnishings normally associated with different types of buildings (see appendix C--CSI MASTERFORMAT listings for Divisions 11 and 12). It is suitable for use at all stages of a building project, from planning through operation and disposal.

Owners, developers, programmers, cost planners, schedulers, architects and engineers, specification writers, operating and maintenance staff, manufacturers, and educators will find UNIFORMAT II useful.

UNIFORMAT II may be used in the following applications:

- Cross filing of product literature and technical guides
- Building performance code formats
- Computer-aided design reference framework
- Preliminary project descriptions
- Construction and operation and maintenance cost databases
- Planning and feasibility studies, and space programming
- Estimating and controlling costs during design and construction
- Economic analysis
- Risk analysis
- Value engineering
- Project scheduling

5.1 Cross-Filing of Product Literature and Technical Guides

Currently, both product literature and technical guides on products in general are filed by using MASTERFORMAT Divisions 1-16, which is an excellent framework for this purpose. There is a need, however, for a cross-filing mechanism that is based on an elemental format. This can be used to locate all products and systems suitable, for example, for exterior wall facings, which may now reside in four or five divisions of the MASTERFORMAT. A need also exists for a mechanism based on an elemental format to locate product literature on prefabricated systems or assemblies such as prefabricated exterior walls, whose component products are found in more than one MASTERFORMAT Division, as well as related technical application guides. UNIFORMAT II is an appropriate elemental format for these uses.

5.2 Building Performance Code Formats

A cross-referencing system for building elements is needed to make building codes more easily accessible by owners and designers. For example, the ability to retrieve necessary information on all code requirements as they apply to exterior wall or partition elements would be a considerable

advantage to the industry. UNIFORMAT II would be an appropriate format for that cross-referencing system.

5.3 Computer-Aided Design Reference Framework

UNIFORMAT II will provide an excellent basis for coding and reference in CAD systems, particularly for the storage and retrieval of standard details. For example, an architect could reference an exterior wall assembly according to UNIFORMAT II element designations and build up a database of standard details structured according to this classification.

5.4 Preliminary Project Descriptions

UNIFORMAT II is suitable for structuring preliminary project descriptions during the conceptual design phase. There are several advantages to this approach. It facilitates the description of the scope of the project for the client in a clear, concise, and logical sequence; it provides the basis for the preparation of more detailed elemental estimates during the early concept and preliminary design phases; and it enhances communications among designers and other participants. This need has been recognized by the Construction Specifications Institute (CSI),[11] which has adopted an elemental format for preliminary project descriptions.

5.5 Construction and Operating and Maintenance Cost Databases

UNIFORMAT II is an effective format for recording construction and operating and maintenance costs in a database. The database can be data from historical project costs, built-up data from detailed unit price databases, or data taken from such publications as the R.S. Means Assemblies Cost Data and Square Foot Cost Data.[12] Further, most current automated cost estimating programs provide the ability to introduce elemental cost classification frameworks in the preparation of estimates and maintenance of databases.

Functional area costs for planning and feasibility estimates can also be structured according to UNIFORMAT II.

---

[11]See "Preliminary Project Description and Outline Specifications" in the Manual of Practice (Alexandria, VA: The Construction Specifications Institute (CSI), 1989).

[12]R.S. Means 1992 Assemblies Cost Data and R.S. Means 1992 Square Foot Cost Data, R.S. Means Company, Inc., Kingston, MA.

5.6 Planning and Feasibility Studies, and Space Programming

Using UNIFORMAT II will facilitate scope definition and the preparation of budgets during the planning and feasibility phases of a project. This provides a link for monitoring the estimates and schedules of subsequent design phases.

UNIFORMAT II can also be used to structure the technical requirements and criteria of space programming.

5.7 Estimating and Controlling Costs During Design and Construction

UNIFORMAT II is an appropriate format for preparing realistic budgets for buildings and establishing elemental cost plans before design commences. It is in principle the work breakdown structure (WBS) specific to buildings which the project manager requires for project cost, time, and quality control. The cost plans set design-to-cost (DTC) targets for each element in the classification at the appropriate level. Thereafter cost estimates and cost monitoring checks will be performed as the design progresses to measure the effectiveness of the design against the cost plan. The pre-bid elemental estimates based on completed plans and specifications can then be converted to MASTERFORMAT Divisions 1-16 or trade categories for use in accelerating bid analysis and subsequent cost control during construction.

5.8 Economic Analysis

Benefit-cost, life-cycle cost, and other methods of economic evaluation can be used to select the most cost-effective alternatives early in the design process and thereby contribute to substantial design and operational savings before decisions have been made that limit options for savings. An elemental classification encourages and facilitates such studies because costs of alternatives being evaluated are readily available from elemental estimates. A work plan for life-cycle cost analyses can be submitted at the beginning of the design process based on the designer's understanding of the project and building elements to be incorporated.

5.9 Risk Analysis

One method of evaluating the economic risk in undertaking a building project is to apply Monte Carlo simulation to develop probability distributions of building costs that enter into the measure of project worth.[13] UNIFORMAT II provides an appropriate classification for developing probability distributions of cost by Individual Elements (Level 3) or by Group Elements (Level 2). The

---

[13]See Ruegg and Marshall, Building Economics: Theory and Practice, pp. 203-256, for a descritpion of Monte Carlo simulation and other risk analysis methods applied to the economic evaluation of buildings.

probability distributions of total project costs for a building alternative are built up by repeated random drawings from the probability distributions of each Level 3 or Level 2 element's costs. The probability distributions of total project costs can then be used to establish an acceptable project contingency, revise the targeted cost consistent with the decision maker's budgetary constraints, establish bidding contingencies, or to serve as inputs to economic analysis.

5.10 Value Engineering (VE)

Most elements represent functions of major building components for which alternatives are generated during the creativity phase of the VE job plan, usually by "directed" brainstorming. Thus, UNIFORMAT II can be used as a check list which, if followed in a logical order, ensures that all elements of the project have been analyzed. In addition, most building system cost models can readily be generated from the elemental cost data, thus saving the VE team considerable time.

5.11 Project Scheduling

Since projects are built element by element, UNIFORMAT II is a suitable framework for developing schedules. It also provides a credible link to cost estimates structured in the same format, and it facilitates the preparation of cash-flow projections early in a project to support financial planning.

5.12 Limitations

UNIFORMAT II includes sitework normally related to buildings, but does not apply to major civil works. It is also unsuitable for process applications or for preparing trade estimates.

6. Relationship to Other Formats

6.1 Elemental Formats

Level 3 elements in UNIFORMAT II are compatible with other North American elemental formats such as the GSA/AIA UNIFORMAT classification, the Tri-Service Work Breakdown Structure (WBS), the classification listed in Chapter 6, Part II, of the CSI Manual of Practice, and that of the CIQS/RAIC classification. UNIFORMAT II is also compatible with international classifications such as the RICS, the CEEC, and elements of the CSI/SfB Construction Index.[14]

6.2 Product Formats

Elemental formats can be tied to product formats. For example, the elements of the original UNIFORMAT have been related to the CSI MASTERFORMAT Divisions 1-16 for a specific design, as shown in Chart 6.1. It is drawn from Chapter B5, "Design and Construction Cost Management," of the American Institute of Architects Handbook of Professional Practice (1984).[15] A similar relationship could be drawn between UNIFORMAT II and product formats. Such a relationship would permit the conversion of elemental estimates to trade estimates at the completion of plans and specifications. This would facilitate bid analyses and the monitoring of progress payments during construction.

---

[14]See Jones, Alan Ray and Clegg, David, CSI/SfB Construction Indexing Manual" (London, England: Royal Institute of British Architects (RIBA) Publications Limited, 1976).

[15]Table 6.1 also appeared in General Services Administration Handbook PBS P 3440.5, Project Estimating Requirments, August 24, 1981. Note that it is based on UNIFORMAT--not UNIFORMAT II.

Chart 6.1 Relationship of UNIFORMAT to MASTERFORMAT

Design Uniformat Level 2	Level 3	Construction UCI	01 General Requirements	02 Sitework	03 Concrete	04 Masonry	05 Metals	06 Wood • Plastic	07 Thermal and Moisture Protect	08 Doors and Windows	09 Finishes	10 Specialties	11 Equipment	12 Furnishings	13 Special Construction	14 Conveying Systems	15 Mechanical	16 Electrical
01 Foundations	011 Standard Foundations			■	■	■												
	012 Spec Foundation Cond			■			■											
02 Substructure	021 Slab On Grade			■	■				■									
	022 Basement Excavation			■														
	023 Basement Walls				■	■			■									
03 Superstructure	031 Floor Construction				■		■	■										
	032 Roof Construction				■		■	■										
	033 Stair Construction				■		■	■										
04 Ext. Closure	041 Exterior Walls				■	■	■	■	■		■	■						
	042 Ext. Doors & Windows									■								
05 Roofing								■	■									
06 Int. Const.	061 Partitions					■		■		■		■						
	062 Interior Finishes				■			■			■							
	063 Specialties						■	■				■						
07 Conveying Sys.																■		
08 Mechanical	081 Plumbing																■	
	082 H.V.A.C.																■	
	083 Fire Protection																■	
	084 Spec. Mechanical Systems																■	
09 Electrical	091 Service & Distribution																	■
	092 Lighting And Power																	■
	093 Spec. Electrical System																	■
10 Gen.Cond. OH&P			■															
11 Equipment	111 Fixed & Movable Equip.												■					
	112 Furnishings													■				
	113 Special Construction														■			
12 Sitework	121 Site Preparation			■														
	122 Site Improvements			■	■	■	■					■					■	
	123 Site Utilities			■													■	■
	124 Off-Site Work			■														

Note: CSI's MASTERFORMAT has superseded the UCI (Uniform Construction Index).

Source: The American Institute of Architects, "Chapter B5 - - Design and Construction Cost Management, " Architect's Handbook of Professional Practice (Washington, DC: American Institute of Architects, 1984).

Appendix A

AUTHOR PROFILES

BRIAN BOWEN

Mr. Bowen is an Executive Vice President of Hanscomb Associates Inc., the U.S. company of the Hanscomb International Group. He was trained as a Quantity Surveyor in the United Kingdom, is a Fellow of the Royal Institution of Chartered Surveyors (FRICS), a Certified Cost Engineer (American Association of Cost Engineers), and a Certified Value Specialist (Society of American Value Engineers). Within Hanscomb, he is responsible for research and development activities within the construction industry, value engineering, and computer applications. He acts as a liaison officer with Hanscomb offices in Europe and Asia. Throughout his career, Mr. Bowen has been active in writing for publications, delivering papers, and training seminars on a wide-range of construction subjects related to building economics. He was the Hanscomb Project Manager in the development of the MASTERCOST system for the American Institute of Architects and UNIFORMAT for the General Services Administration. He has consulted to the American Institute of Architects in developing new educational programs for project cost control for the architectural profession. Together with Mr. Charette, he co-chairs the ASTM Subcommittee Task Group on a standard classification for building elements and related sitework.

ROBERT P. CHARETTE

Mr. Charette, a professional engineer, is Vice President of Le Groupe Hanscomb Inc. in Montreal and Director of Value Engineering and Life Cycle Costing Services for Hanscomb Consultants in Canada. He serves as Secretary of the ASTM Building Economics Subcommittee (E06.81). He is a member of the Building Economics Working Commission (W.55) of the International Council for Building Research Studies and Documentation (CIB), the Canadian Construction Research Board of the National Research Council of Canada (Quebec Chapter), the Canadian Institute of Quantity Surveyors (CIQS), Construction Specifications Canada (CSC), the Construction Specifications Institute (CSI), the Society of American Value Engineers (SAVE) with which he is accredited as a Certified Value Specialist (CVS), and the Association Francaise pour l'Analyse de la Valeur (AFAV). Mr. Charette has taught Building Economics and Value Engineering as a lecturer and seminar leader at several universities at both the undergraduate and post graduate levels, including the Schools of Architecture and Engineering at the University of Montreal, the University of Quebec in Montreal, the Ecole de Technologie Superieure, the Technical University of Nova Scotia, the University of Waterloo, the McGill Management Institute, the University of Wisconsin, and the Harvard Graduate School of Design. He co-chairs with Mr. Bowen the ASTM Subcommittee Task Group on a standard classification for building elements and related sitework.

HAROLD E. MARSHALL

Dr. Marshall heads the Office of Applied Economics at the National Institute of Standards and Technology. His specialty is developing standard economic methods and risk analysis techniques for evaluating investment projects. Dr. Marshall is co-author of a recent book on building economics, and has published over 40 articles, chapters in books, and technical papers. He chairs for the American Society for Testing and Materials The Building Economics Subcommittee which has produced seven standard economic methods used worldwide for evaluating investments in buildings and construction. Dr. Marshall also leads the task group on economic methods in the Building Economics Working Commission (W.55) of the International Council for Building Research Studies and Documentation (CIB). His post as advisory editor to the international journal Construction Management and Economics helps keep him abreast of developments abroad in building economics. A graduate of The George Washington University (Ph.D. in 1969, M.A., 1965, and B.A., 1964), Dr. Marshall's early career included teaching economics for two years on World Campus Afloat's around-the-world shipboard college and performing economic research at the Department of Agriculture. In recognition of his contributions in building economics, Dr. Marshall received in 1986 the American Association of Cost Engineers' highest honor, the Award of Merit, and in 1988 the American Society for Testing and Materials' Award of Merit and accompanying honorary title of Fellow of the Society.

Appendix B

CSI MASTERFORMAT Titles for Divisions 1-16

1 GENERAL REQUIREMENTS

2 SITEWORK

3 CONCRETE

4 MASONRY

5 METALS

6 WOOD AND PLASTICS

7 THERMAL AND MOISTURE PROTECTION

8 DOORS AND WINDOWS

9 FINISHES

10 SPECIALTIES

11 EQUIPMENT

12 FURNISHINGS

13 SPECIAL CONSTRUCTION

14 CONVEYING SYSTEMS

15 MECHANICAL

16 ELECTRICAL

Appendix C

CSI MASTERFORMAT Broadscope Section Titles for Divisions 11—Equipment, 12—Furnishings, and 13—Special Construction*

DIVISION 11—EQUIPMENT

11010 MAINTENANCE EQUIPMENT
11020 SECURITY AND VAULT EQUIPMENT
11030 TELLER AND SERVICE EQUIPMENT
11040 ECCLESIASTICAL EQUIPMENT
11050 LIBRARY EQUIPMENT
11060 THEATER AND STAGE EQUIPMENT
11070 INSTRUMENTAL EQUIPMENT
11080 REGISTRATION EQUIPMENT
11090 CHECKROOM EQUIPMENT
11100 MERCANTILE EQUIPMENT
11110 COMMERCIAL LAUNDRY AND DRY CLEANING EQUIPMENT
11120 VENDING EQUIPMENT
11130 AUDIO-VISUAL EQUIPMENT
11140 VEHICLE SERVICE EQUIPMENT
11150 PARKING CONTROL EQUIPMENT
11160 LOADING DOCK EQUIPMENT
11170 SOLID WASTE HANDLING EQUIPMENT
11190 DETENTION EQUIPMENT
11200 WATER SUPPLY AND TREATMENT EQUIPMENT
11280 HYDRAULIC GATES AND VALVES
11300 FLUID WASTE TREATMENT AND DISPOSAL EQUIPMENT
11400 FOOD SERVICE EQUIPMENT
11450 RESIDENTIAL EQUIPMENT
11460 UNIT KITCHENS
11470 DARKROOM EQUIPMENT
11480 ATHLETIC, RECREATIONAL, AND THERAPEUTIC EQUIPMENT
11500 INDUSTRIAL AND PROCESS EQUIPMENT
11600 LABORATORY EQUIPMENT
11650 PLANETARIUM EQUIPMENT
11660 OBSERVATORY EQUIPMENT
11680 OFFICE EQUIPMENT
11700 MEDICAL EQUIPMENT
11780 MORTUARY EQUIPMENT
11850 NAVIGATION EQUIPMENT
11870 AGRICULTURAL EQUIPMENT

*These Divisions are currently under review by CSI.

Appendix C (continued)

DIVISION 12—FURNISHINGS

12050 FABRICS
12100 ARTWORK
12300 MANUFACTURED CASEWORK
12500 WINDOW TREATMENT
12600 FURNITURE AND ACCESSORIES
12670 RUGS AND MATS
12700 MULTIPLE SEATING
12800 INTERIOR PLANTS AND PLANTERS

DIVISION 13—SPECIAL CONSTRUCTION

13010 AIR SUPPORTED STRUCTURES
13020 INTEGRATED ASSEMBLIES
13030 SPECIAL PURPOSE ROOMS
13080 SOUND, VIBRATION, AND SEISMIC CONTROL
13090 RADIATION PROTECTION
13100 NUCLEAR REACTORS
13120 PRE-ENGINEERED STRUCTURES
13150 AQUATIC FACILITIES
13175 ICE RINKS
13180 SITE CONSTRUCTED INCINERATORS
13185 KENNELS AND ANIMAL SHELTERS
13200 LIQUID AND GAS STORAGE TANKS
13220 FILTER UNDERDRAINS AND MEDIA
13230 DIGESTER COVERS AND APPURTENANCES
13240 OXYGENATION SYSTEMS
13260 SLUDGE CONDITIONING SYSTEMS
13300 UTILITY CONTROL SYSTEMS
13400 INDUSTRIAL AND PROCESS CONTROL SYSTEMS
13500 RECORDING INSTRUMENTATION
13550 TRANSPORTATION CONTROL INSTRUMENTATION
13600 SOLAR ENERGY SYSTEMS
13700 WIND ENERGY SYSTEMS
13750 COGENERATION SYSTEMS
13800 BUILDING AUTOMATION SYSTEMS
13900 FIRE SUPPRESSION AND SUPERVISORY SYSTEMS
13950 SPECIAL SECURITY CONSTRUCTION

Appendix D

References

American Institute of Architects. "Chapter B5--Design and Construction Cost Management," Architect's Handbook of Professional Practice (Washington, DC: American Institute of Architects, 1984).

Bowen, B. and Charette, R. P. "Elemental Cost Classification Standard For Building Design," 1991 American Association of Cost Engineers (AACE) Transactions, Seattle, WA, 1991.

Canadian Institute of Quantity Surveyors. Elemental Cost Analysis--Method of Measurement and Pricing (Toronto, Ontario, Canada: Canadian Institute of Quantity Surveyors, first issued 1972, revised 1990).

Charette, Robert P. and Huxley, Anthony L. "The Case for a National Elemental Design/Cost Classification Standard" (Preview 2000, 6th Canadian Building Congress, December 1990).

Construction Specifications Institute. Chapter 6, Part II, "Preliminary Project Description and Outline Specifications," Manual of Practice (Alexandria, VA: The Construction Specifications Institute, 1989).

Construction Specifications Institute. MASTERFORMAT (Alexandria, VA: The Construction Specifications Institute, 1988 edition).

Cox, B. J. and Horsley, William. "Square Foot Estimating," R. S. Means Company, Inc., Kingston, MA.

Dell'Isola, A. J. and Kirk, S. J. Life-Cycle Costing for Design Professionals (New York, NY: McGraw-Hill, Inc., 1981).

Dell'Isola, A. J. and Parker, D. E. Project Budgeting in Buildings (New York, NY: Van Nostrand Reinhold, 1990).

General Services Administration. Handbook PBS P 3440.5, Project Estimating Requirements (Washington, DC: General Services Administration, August 24, 1981).

Hanscomb Associates, Inc. Automated Cost Control & Estimating System (Washington, DC: General Services Administration, 1975).

Johnson, R. W. "Trends in Formats," The Construction Specifier, June 1991.

Jones, A. R. and Clegg, D. CSI/SfB Construction Indexing Manual--1976 (London, England: Royal Institute of British Architects (RIBA) Publications Limited, 1976).

References (continued)

Marshall, Harold E. Techniques for Treating Uncertainty and Risk in the Economic Evaluation of Building Investments, National Institute of Standards and Technology Special Publication 757, September 1988.

Marshall, Harold E. and Ruegg, Rosalie T. Recommended Practice for Measuring Benefit/Cost and Savings-to-Investment Ratios for Buildings and Building Systems, National Bureau of Standards Interagency Report 81-2397, November 1981.

Marshall, Harold E. Recommended Practice for Measuring Net Benefits and Internal Rates of Return for Investments in Buildings and Building Systems, National Bureau of Standards Interagency Report 83-2657, October 1983.

Marshall, Harold E. Recommended Practice for Measuring Simple and Discounted Payback for Investments in Buildings and Building Systems, National Bureau of Standards Interagency Report 84-2850, March 1984.

Royal Institute of Chartered Surveyors, Standard Form of Cost Analysis (London, England: The Building Cost Information Service, 1969 (Reprinted December 1987)).

Ruegg, Rosalie T. and Marshall, H. E. Building Economics: Theory and Practice (New York, NY: Van Nostrand Reinhold, August 1990).

Ruegg, Rosalie T., Petersen, Stephen R., and Marshall, Harold E. Recommended Practice for Measuring Life-Cycle Costs of Buildings and Building Systems, National Bureau of Standards Interagency Report 80-21040, June 1980.

Uman, D. M. "Is a Standard Needed for Estimating Building Design and Construction Cost?" Cost Engineering, Vol. 32, No. 8, August 1990.

NIST-114A
(REV. 3-90)

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

BIBLIOGRAPHIC DATA SHEET

1. PUBLICATION OR REPORT NUMBER
NIST/SP-841

2. PERFORMING ORGANIZATION REPORT NUMBER

3. PUBLICATION DATE
August 1992

4. TITLE AND SUBTITLE

UNIFORMAT II--A Recommended Classification for Building Elements and Related Sitework

5. AUTHOR(S)

Brian Bowen, Robert P. Charette, and Harold E. Marshall

6. PERFORMING ORGANIZATION (IF JOINT OR OTHER THAN NIST, SEE INSTRUCTIONS)

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
GAITHERSBURG, MD 20899

7. CONTRACT/GRANT NUMBER

8. TYPE OF REPORT AND PERIOD COVERED
final

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (STREET, CITY, STATE, ZIP)

U.S. Department of Commerce
National Institute of Standards and Technology
Gaithersburg, MD 20899

10. SUPPLEMENTARY NOTES

11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.)

This report describes UNIFORMAT II, a format for classifying building elements and related sitework. Elements, as defined here, are major components common to most buildings. Elements usually perform a given function, regardless of the design specification, construction method, or materials used. Elements are also commonly referred to as systems or assemblies. Using UNIFORMAT II ensures consistency in the economic evaluation of building projects over time and from project to project, and it enhances reporting at all stages in construction--from feasibility and planning through the preparation of working documents, construction, maintenance, rehabilitation, and disposal. UNIFORMAT II is a significant advance over the original UNIFORMAT classification because the new version is the result of an intensive industry review and has added elements and expanded descriptions of many existing elements. Performing an economic analysis based on an elemental framework instead of on a product-based classification reduces the time and costs for evaluating alternatives at the design stage, and thereby encourages more economic analyses and more economically efficient choices among buildings and building elements. Collecting capital, operating, and maintenance costs according to UNIFORMAT II is an efficient approach to project evaluation using life-cycle cost, net benefits, rate-of-return, and payback analyses. Elements are classified in three hierarchical levels of definition. Level 1 identifies seven Major Group Elements, such as the Substructure, Shell, and Interiors. Level 2 further subdivides Level 1 into Group Elements. The Shell, for example, includes the Superstructure, Exterior Closure, and Roofing. Level 3 breaks the Group Elements further into Individual Elements. Exterior Closure, for example, includes Exterior Walls, Windows, and Exterior Doors. UNIFORMAT II produces additional benefits such as providing a format for collecting and analyzing historical data to use in estimating and budgeting future projects; providing a check list for the cost estimation process as well as the creativity/brainstorming phase of value engineering procedures; providing a basis for training in cost estimation; facilitating communications among members of a project team regarding costs and scope of work in each discipline; and establishing a database for automated cost estimating. Owners, developers, programmers, cost planners, schedulers, architects and engineers, operating and maintenance staff, manufacturers, specification writers, and educators will find the classification useful.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)

building economics; building elemental format; building functional elements; building systems classification; cost estimation; cost planning; design economics; elemental building classification; elemental/systems specifications; standard classification of building systems; UNIFORMAT; value engineering

13. AVAILABILITY

X	UNLIMITED
	FOR OFFICIAL DISTRIBUTION. DO NOT RELEASE TO NATIONAL TECHNICAL INFORMATION SERVICE (NTIS).
X	ORDER FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, DC 20402.
X	ORDER FROM NATIONAL TECHNICAL INFORMATION SERVICE (NTIS), SPRINGFIELD, VA 22161.

14. NUMBER OF PRINTED PAGES
51

15. PRICE

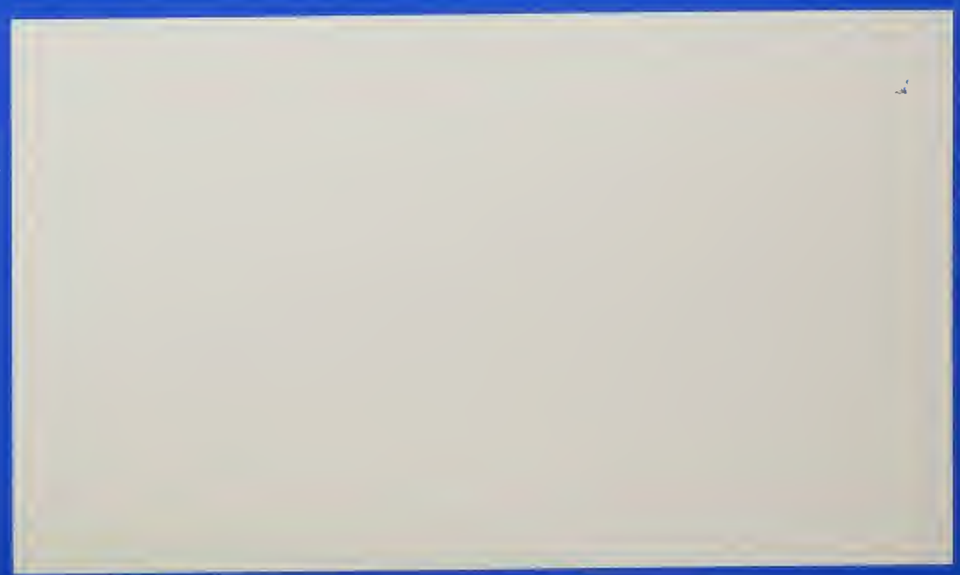
ELECTRONIC FORM

UNIFORMAT II Classification of Building Elements (continued)

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
SERVICES (continued)	Fire Protection	Sprinkler Systems Stand-Pipe Systems Fire Extinguishers Special Fire Protection
	Electrical	Service & Distribution Lighting & Branch Wiring Communication & Security Systems Special Electrical Systems
EQUIPMENT & FURNISHING	Equipment	User defined elements using CSI MASTERFORMAT Division 11--Equipment
	Furnishings	User defined elements using CSI MASTERFORMAT 12--Furnishings
SPECIAL CONSTRUCTION & DEMOLITION	Special Construction	User defined elements using CSI MASTERFORMAT 13--Special Construction
	Selective Building Demolition	Building Elements Hazardous Components

UNIFORMAT II Classification of Building-Related Sitework

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
BUILDING SITEWORK	Site Preparation	Site Clearing Site Demolition and Relocations Site Earthwork Hazardous Waste Remediation
	Site Improvements	Roadways Parking Lots Walks & Terraces Site Development Landscaping
	Site Civil/Mechanical Utilities	Water Supply & Distribution Systems Sanitary Sewer Systems Storm Sewer Systems Heating Distribution Cooling Distribution Gas Distribution System Other Civil/Mechanical Utilities
	Site Electrical Utilities	Electrical Distribution Exterior Lighting Exterior Communications & Security Other Electrical Utilities
	Other Site Construction	Service Tunnels Other Site Systems & Equipment

U.S. Department of Commerce
National Institute of Standards and Technology
Gaithersburg, MD 20899

Official Business
Penalty for Private Use $300